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Supplementary Information

Super-thermostable, flexible supercapacitor for ultralight and high performance devices

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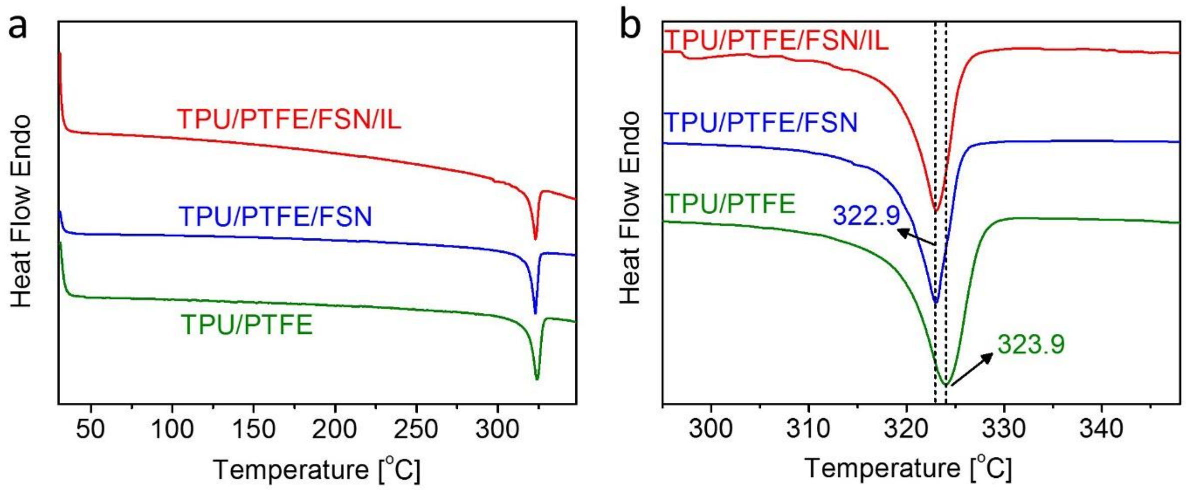

Figure S1. (a) DSC measurements of TPU/PTFE, TPU/PTFE/FSNs, and TPU/PTFE/FSNs/ILs composite electrolytes. (b) The shift in T_m for PTFE.

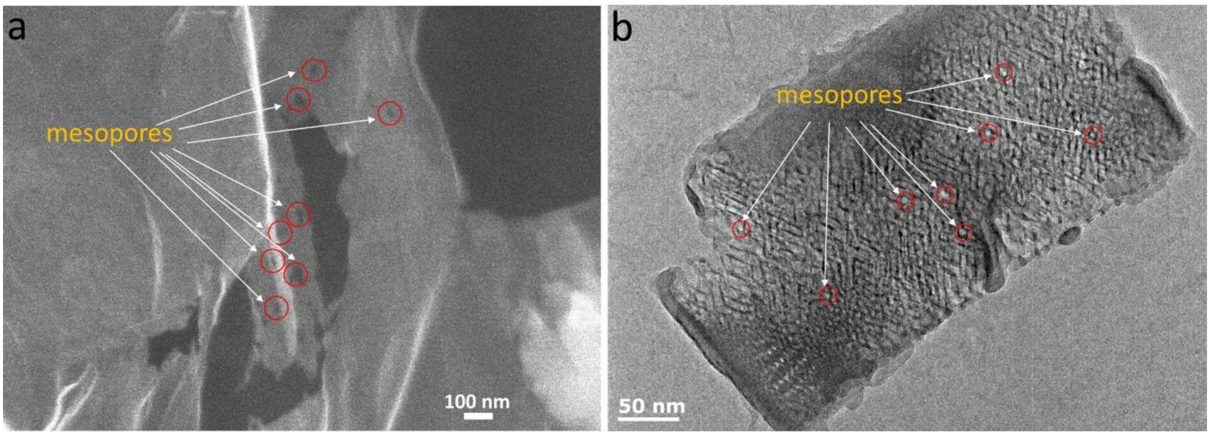

Figure S2. (a) FE-SEM and (b) HR-TEM images showing the mesopores of the graphene aerogels.

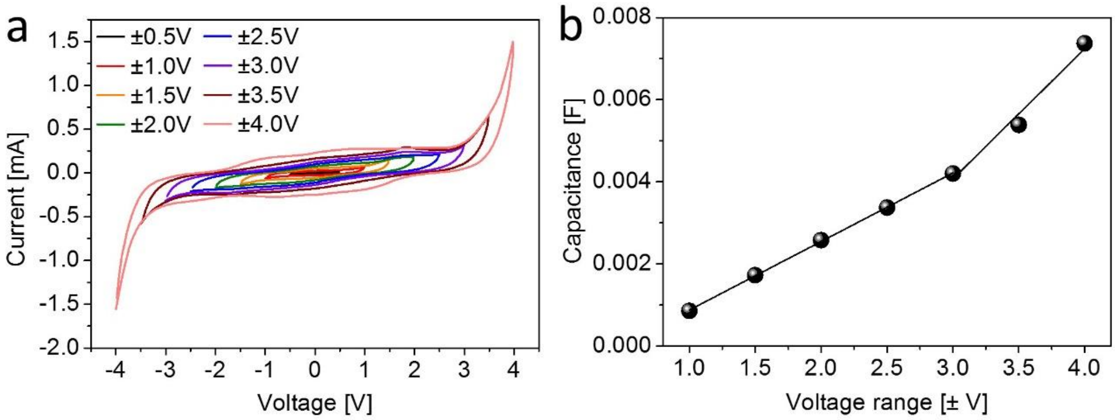

Figure S3. (a) CV measurements as a function of voltage condition in the range of ±4V, and (b) capacitance values calculated from CV results. To investigate the operating voltage ranges of the composite polymer electrolyte, the measurements have been carried out by using composite polymer electrolytes and the commercial current corrector without active materials.

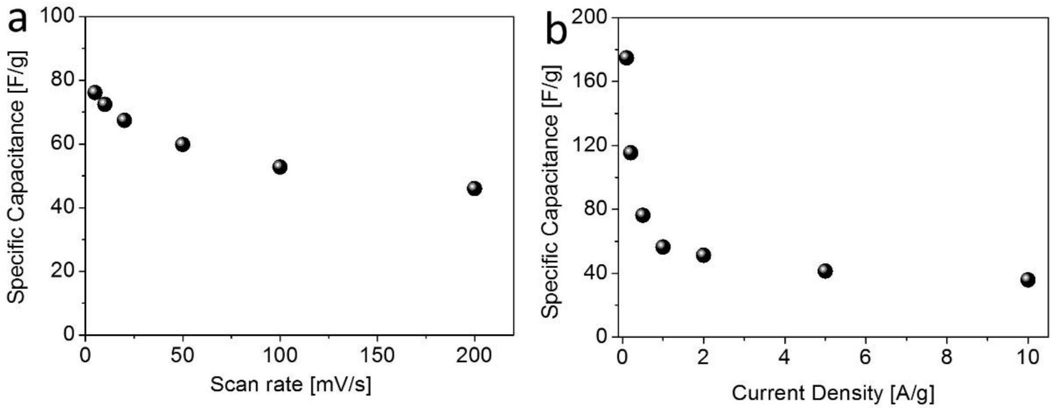

Figure S4. (a) Specific capacitance values calculated from the CV curves of Fig. 3c as a function of various scan rates in the range of 5 to 200 mV/s. (b) Specific capacitance values calculated from the CD curves of Fig. 3d.

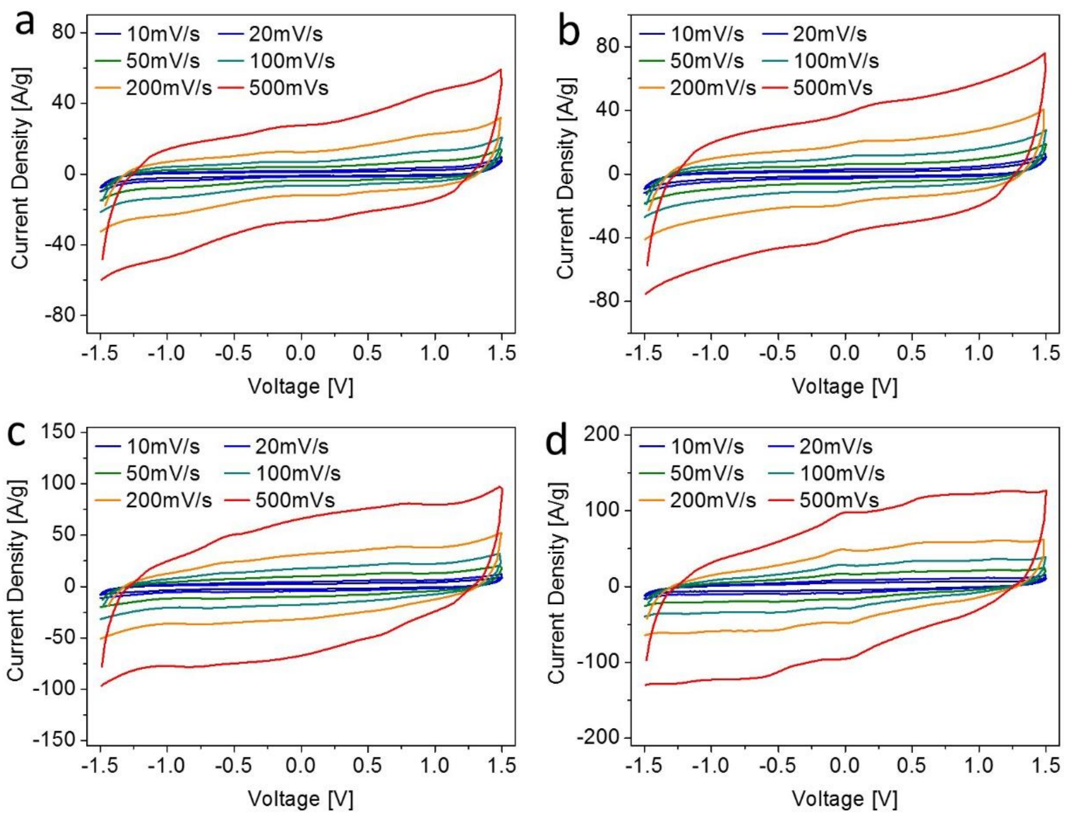

Figure S5. CV profiles as a function of scan rates at 50 °C (a), 80 °C (b), 120 °C (c), and 160 °C (d).

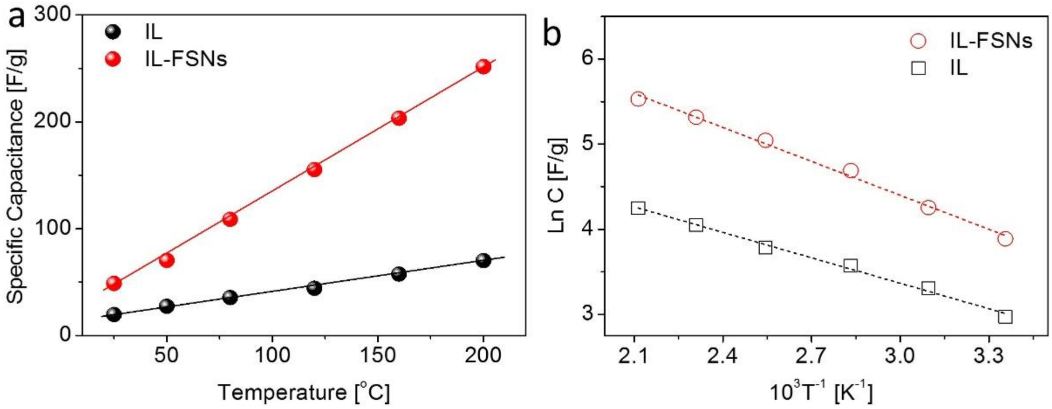

Figure S6. (a) Plots of temperature vs specific capacitance of the supercapacitor device calculated from CV curves of Fig. 4a. (b) Arrhenius plot of specific capacitance calculated from the CV curves vs inverse temperature for the kinetics of ionic transport. The activation energy of the supercapacitor was calculated to be 11 kJ/mol.

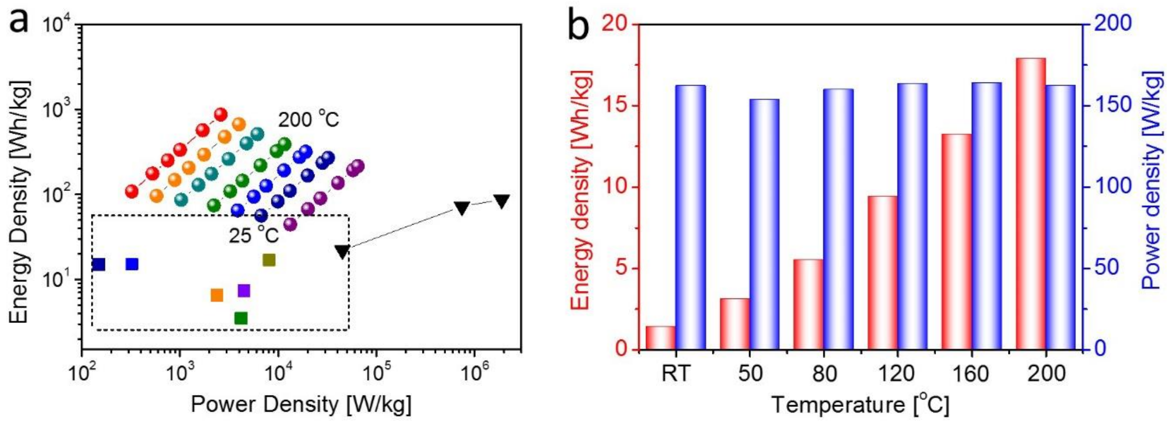

Figure S7. (a) Ragone plots derived from CV measurements of Fig. 4a and 4b, which are compared with previously reported supercapacitors.[1-5] (b) Energy and power densities calculated using the total mass of devices.

Table S1. Comparison of specific capacitances, and energy and power densities using graphene or CNTs electrodes and IL-based solid-state electrolytes at room temperature.

Electrode	Electrolyte	OPW[V]	Cs[F/g]	Cycles(retention%)	Es[Wh/kg]	Ps[kW/kg]	Ref
Graphene aerogel	IL-FSNs/TPU/PTFE	0~1.5	1007(1A/g)	10000(>90%)	1134	4.3	This work(200 °C)
Graphene aerogel	IL-FSNs/TPU/PTFE	0~1.5	174 (0.1A/g)	10000(>95%)	63	3	This work(25 °C)
GNC	EMIMBF4/PVdf-HEP	0~3.5	180(1.0A/g)	10000(>85%)	75	20	6
rGO	BMIMTFSI/TPU/clay	0~2.5	14(2.0A/g)	N/A	22.118	45	7
rGO Film	EMIMBF4/c-PVA/c-pHEMA	0~2.0	31(0.1A/g)	100000(>91%)	N/A	N/A	8
HEG	BMIMTFSI/PAN	0~3.0	108(1.0A/g)	1000(>92%)	30.51	~6	9
NFC(Gr/CNT buckpaper)	EMIMTFSI/triehoxysilane functional(PEO-PPO-PEO)	0~3.5	78.6(0.2A/g)	50000(>96.3%)	66.756	0.1756	10
Gr doped Carbon	Go doped EMIMBF4/P(Vdf-HFP)	0~3.5	190(1.0A/g)	5000(>80%)	76	0.84	11
rGO	LiClO4/EMIMBF4/BEM/PEO	0~3.2	38.87(0.5A/g)	5000(>91.2%)	54.2	0.79	12
PAGH(Hydrogel)	H2SO4/PVA	0~1.0	248.8(1.0A/g)	10000(>86.2%)	26.5	0.132	13
SWCNT	EMIMBF4/MBAA/DMAA	0~2.5	50.3(0.251A/g)	5000(>93.4%)	N/A	N/A	14
MWCNT	EMIMBF4/P(Vdf-HFP)	0~2.0	113.6(0.492A/g)	8000(>74.0%)	15.15	0.326	4
f-MWCNT	EMIMFSI/PVDF-HFP/Silica	± 2.0	80.7(0.3A/g)	2000(91%)	32.2	0.9	15
Commercial cabon	EMIMTFSI/P(Vdf-co-HFP)	0~2.5	~140(1.0A/g)	10000(>97%)	21.9	6.25	16
Commercial A.C	BMIM(BF4,TFSI)/VBI(BF4,TFSI)/PEGDA	0~3.0	175.6(1.0A/g)	10000(>95.2%)	N/A	N/A	17
Commercial carbon	Go doped EMIMBF4/P(Vdf-HFP)	0~3.5	190(1.0A/g)	5000(>80%)	76	0.84	18
A.C	LiClO4/PAEK/PEG	0~1.5	92.84(0.1A/g)	N/A	7.4	4.5	19

Table S2. Comparison of specific capacitances and cycle stabilities at various bending angles and/or high temperatures.

Electrode	Electrolyte	OPW [V]	Temperature [℃]	Bending angle [°]	Capacitance [F/g]	Cycle number	Retention [%]	References
rGO Film	EMIMBF4/c-PVA/c-PHEMA	0~2.0	180	0	88 at 2 A/g	1,000	90.2 at 1.0 A/g	8
			150	60~180	na	100,000	91 at 2.0 A/g	8
rGO-PBI	H3PO4 doped PBI	± 0.5	160	0	170 at 50 mV/s	100,000	93 at 3.6 A/g	20
			120	60~180	na	1,000	100 at 1.0 A/g	20
A.C	LiClO4/PAEK/PEG	0~1.5	120	0	103.17 at 0.1 A/g	2,000	90.8 at 0.5 A/g	18
A.C	EMIMTFSI in glass-fiber membrane	0~2.5	120	0	107 at 1.0 A/g	10,000	75 at 5.0 A/g	21
			120	Rc=0.05~0.2 mm	na	400	100 at 1.0 A/g	21
A.C	TMSPMIMCl/pPBI	0~1.0	120	0	85.5 at 0.05 A/g	10,000 at RT	91.0 at 1.0 A/g	22
A.C	BMIM(BF4,TFSI)/VBI(BF4,TFSI)/PEGDA	0~3.0	120	0	277.4 at 1.0 A/g	5,000 at RT	95.2 at 1.0 A/g	16
CNG	EMIMBF4/PVdf-HFP	0~3.5	25	0~180	180 at 1.0 A/g	1,000	88.3 at 1.0A/g	6
NFC(Gr/CNT buckpaper)	EMIMTFSI/triehoxysilane functional(PEO-PPO-PEO)	0~3.5	25	Rc=3~10 mm	78.6 AT 0.2 A/g	50,000	98.4 at 0.2 A/g	10

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